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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OPP OFFICIAL RECORD
HEALTH EFFECTS DIVISION
SCIENTIFIC DATA REVIEWS
EPA SERIES 361

MAR 11 1996

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Dicamba. Case 0065. Residue Data in Grass Forage and Hay. MRID 43370701. CBRS 14378. DP Barcode:D207649.

FROM: Leung Cheng, Chemist *Leelheng*
Special Review Section I
Chemistry Branch II - Reregistration Support
Health Effects Division (7509C) *DPR*

THROUGH: Andrew R. Rathman, Section Head
Chemistry Branch II - Reregistration Support
Health Effects Division (7509C)

TO: Jane Mitchell, CRM
Reregistration Branch
Special Review/Reregistration Division (7508W)

Attached please find a review of grass residue data submitted by Sandoz Agro Inc in response to the Dicamba (SRR) Registration Standard (6/30/89). These data were reviewed by Dynamac Corporation under the supervision of CBRS, HED. This information has undergone secondary review in CBRS and is consistent with Agency policies.

The submitted study is acceptable. The submitted grass field trials support a maximum label use rate of 2.0 lbs ae/A. The field trial data indicate that dicamba residue levels are not dependent on the salt formulation used. The registrant has stated that the potassium salt is not marketed for use on pasture or grass crops (letter of 5/17/94, MRID 43274500).

Based on the residue data reflecting 2.0 lb ae/A, tolerances of 400 ppm and 600 ppm would be appropriate for grass forage and hay, respectively. Tolerances are established for grass forage and hay using the 0-day PHI data. The registrant must amend all product labels registered for use on rangeland and pasture grasses to indicate the maximum use rate of 2 lb ae/A per season. In addition, the Agency currently considers feeding restrictions, preslaughter intervals, and PHIs greater than zero days impractical

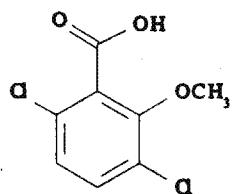
for pasture and rangeland grasses (see Table II, 9/95). All product labels must be amended appropriately.

Based on the ruminant metabolism data discussed in CBRS 13874 (L. Cheng, 3/7/96), increase in the tolerance levels in grass forage and hay will not lead to a tolerance increase in meat (0.2 ppm), fat (0.2 ppm), meat byproducts (0.2 ppm), liver (1.5 ppm), and milk (0.3 ppm). However, an increase to 5 ppm from the current tolerance level of 1.5 ppm in kidney will be needed.

Attachment - Dynamac review of Registrant's Response to Residue Chemistry Data Requirements

cc (with Attachment) :Circ, RF, Reg Std File, Cheng
RDI:ARRathman:2/26/96:RBPerfetti:3/6/96:EZager:3/5/96
7509C:CBRS:LCheng:CM#2:RM804D:2/16/96:■05:DICAMBA\GRASS

DICAMBA



(Shaughnessy No. 029801, Case No. 0065)

CBRS No. 14378; DP Barcode D207649

REGISTRANT'S RESPONSE TO RESIDUE CHEMISTRY DATA REQUIREMENTS

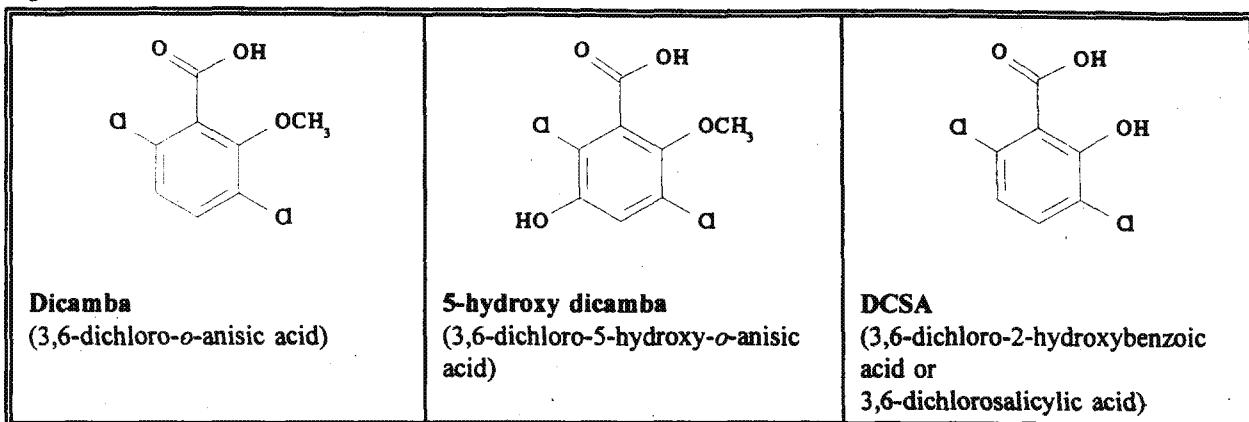
BACKGROUND

The Dicamba Second Round Review (SRR) dated 6/89 required additional field trial data depicting residues of dicamba and its 5-hydroxy metabolite in/on grasses. In response, Sandoz Agro, Inc. submitted a draft protocol for grass field trials (CBRS Nos. 11617 and 11626, DP Barcodes D189393 and D189595, S. Knizner, 6/11/93 and CBRS No. 12546, DP Barcode D195031, R. Perfetti, 10/20/93). The Agency concluded that the registrant should minimally conduct 14 field trials using any one dicamba salt formulation and four side by side trials comparing the other proposed dicamba salt formulations (Na^+ , DMA^+ , and DGA^+). All field trials were to represent the maximum label rate and minimum PHI. In response, Sandoz has submitted grass forage and hay field trials (1994; MRID 43370701). These data are reviewed here for their adequacy in fulfilling residue chemistry data requirements. The Conclusions and Recommendations stated herein pertain only to data requirements for magnitude of the residue in plants.

The qualitative nature of the residue in plants is adequately understood. The residues of concern in/on plant commodities (except asparagus, soybeans, and soybean forage and hay) are dicamba and its 5-hydroxy metabolite (3,6-dichloro-5-hydroxy-o-anisic acid). The residues of concern in/on asparagus, soybeans, and soybean forage and hay are dicamba and its metabolite 3,6-dichloro-2-hydroxybenzoic acid (3,6-dichlorosalicylic acid; DCSA).

Tolerances for residues in/on plants (excluding soybeans, soybean forage and soybean hay) and processed food/feed commodities are currently expressed in terms of the combined residues of dicamba (3,6-dichloro-o-anisic acid) and its 5-hydroxy metabolite [40 CFR §180.227(a), §185.1800, and §186.1800]. Tolerances for residues in/on soybeans, soybean forage and soybean hay, and in animal commodities are expressed in terms of the combined residues of dicamba and its DCSA metabolite [40 CFR §180.227(b)]. The chemical structures of dicamba and its metabolites are shown in Figure 1. There are no Codex MRLs for residues of dicamba; therefore, issues of compatibility between U.S. tolerances and Codex MRLs do not exist.

Figure 1. Chemical names and structures of dicamba and its metabolites.



The Pesticide Analytical Manual (PAM) Vol. II lists Method I and II, GC methods with electron capture detection (GC/ECD), for the enforcement of tolerances on dicamba and its metabolite 5-hydroxy dicamba in/on plant commodities and milk.

CONCLUSIONS AND RECOMMENDATIONS

1. The submitted grass field trials support a maximum label use rate of 2.0 lbs ae/A. In their letter of 5/17/94 (MRID 43274500), the registrant states that the potassium salt is not marketed for use on pasture or grass crops. The field trial data indicate that dicamba residue levels are not dependent on the salt formulation used. Following a single application of the DMA⁺, DGA⁺, or Na⁺ salt SC/L formulations to actively growing grass at 0.5 lb ae/A with a 0-day PHI, the combined residues of dicamba and its 5-hydroxy metabolite were 20-81 ppm in on 23 forage samples and 5.7-472 ppm in/on 23 hay samples. The hay sample with the maximum residues at this treatment rate is an average of two analyses of a single field sample and appears to be an outlier. The combined residues were 5.7-120 ppm in/on the 22 other hay samples collected from the 0.5 lb ae/A, 0-day PHI trials. Following a single application of the DMA⁺ SC/L salt formulation at 1.0 lb ae/A with a 0-day PHI, the combined residues of dicamba and 5-hydroxy dicamba were 34-121 ppm in/on 13 forage samples and 22-231 ppm in/on 13 hay samples. Following a single application of the DMA⁺, DGA⁺, or Na⁺ salt SC/L formulations at 2.0 lb ae/A with a 0-day PHI, the combined residues were 66-358 ppm in/on 23 forage samples and 34-565 ppm in/on 23 hay samples.
2. Based on the residue data reflecting 2.0 lb ae/A, tolerances of 400 ppm and 600 ppm would be appropriate for grass forage and hay, respectively.
3. The registrant must amend all product labels registered for use on rangeland and pasture grasses to indicate the maximum use rate of 2 lb ae/A per season. In addition, the Agency currently considers feeding restrictions, preslaughter intervals, and PHIs

greater than zero days impractical for pasture and rangeland grasses (see the Updated Livestock Feeds Table for Subdivision O of the Pesticide Assessment Guidelines, 6/2/94). All product labels must be amended appropriately. Tolerances are set for grass forage and hay using the 0-day PHI data.

DETAILED CONSIDERATIONS

Residue Analytical Methods

In conjunction with the grass field trials, Sandoz (1994; MRID 43370701) submitted a method description for the analysis of dicamba and its 5-hydroxy metabolite in/on grasses forage and hay. The method, AM-0691B, has been previously reviewed and deemed adequate for data collection and tolerance enforcement for residues in/on plant commodities (CBRS No. 12482, DP Barcode D194776, D. Miller, 12/14/93).

Briefly, residues of dicamba and 5-hydroxy dicamba are hydrolyzed with 1N HCl for 1.5 hours in a 95 C water bath. The pH is adjusted to ≥ 8 and readjusted to < 1 . Residues are extracted with ethyl ether, concentrated, methylated with diazomethane, and cleaned up by silica gel column chromatography prior to analysis by GC/ECD. The limit of detection is 0.01 ppm for each analyte. Chromatograms and sample calculations were provided. The analyses were conducted by ChemAlysis Inc., Savage, MD.

Concurrent recovery data were submitted for 51 forage and 52 hay samples fortified at 0.01-500 ppm of dicamba and at 0.01-100 ppm of 5-hydroxy dicamba. Concurrent recoveries were 66 - 119% (Table 1). For forage, dicamba residues were nondetectable (< 0.01 ppm) in/on 21 controls and 0.012-0.29 ppm in/on 47 controls; 5-hydroxy dicamba residues were < 0.01 ppm in/on 41 controls and 0.011-0.22 ppm in/on 24 controls. For hay, dicamba residues were < 0.01 ppm in/on 13 controls and 0.011-0.22 ppm in/on 53 controls; 5-hydroxy dicamba residues were < 0.01 ppm in/on 35 controls and 0.01-0.10 ppm in/on 31 controls.

Table 1. Concurrent recoveries of dicamba and 5-hydroxy dicamba from fortified control samples.

Analyte	Fortification Level (ppm)	% Recovery ^a	
		Grass forage	Grass hay
Dicamba	0.01-500	70-113 (51)	66-117 (52) ^b
5-OH	0.01-100	74-106 (51)	70-119 (52)

^a The number of samples is listed parenthetically.

^b One control hay sample fortified at 0.01 ppm had a recovery outside of the acceptable 70-120% range.

Storage Stability Data

The registrant submitted data depicting the frozen storage stability of dicamba and its 5-hydroxy metabolite in/on grasses forage and hay. Treated field forage and hay samples were initially analyzed within 72-79 days of harvest and again after 224-320 days of additional frozen (<-5 C) storage. The initial analyses were compared to the analyses of the same samples after the additional storage interval. Dicamba residues in/on treated forage and hay samples were 1.2-138 ppm on initial analysis and 1.8-129 ppm on reanalysis after the additional storage period. The 5-hydroxy dicamba residues in/on treated forage and hay samples were 2.7-63 ppm on initial analysis and 2.8-74 ppm on reanalysis. Recoveries after storage were generally 75-180% (Table 2). These data indicate that residues of dicamba and 5-hydroxy dicamba are stable in/on frozen grass forage and hay for up to 314 and 320 days, respectively (10 months). The submitted storage stability data are adequate to support the storage interval and conditions (13 months, <-1 C) of the current submission. No additional storage stability data are required.

Table 2. Recoveries after frozen storage treated grasses forage and hay field samples.

Commodity	Number of Samples	Initial Storage Interval (days)	Additional Storage Interval (days)	% Recovery after storage	
				Dicamba	5-OH dicamba
Forage	15-16	76-79	224-314	94-180	59-150 ^a
Hay	15-17	72-75	223-320	49-150 ^b	64-145

^a The recovery after storage of only one sample was <75%.

^b The recovery after storage from only one sample was <80%.

Magnitude of the Residue in Plants

A tolerance of 40.0 ppm has been established for the combined residues of dicamba and its metabolite 5-hydroxy metabolite in/on each pasture grasses, rangeland grasses, and grass hay [40 CFR § 180.227 (a)].

A REF's search dated 11/16/94 identified three dicamba end-use products registered to Sandoz for use on pasture and rangeland grasses harvested as forage or hay: two DMA⁺ salt formulations, a 4.0 and 1.0 lb/gal SC/Ls (EPA Reg. Nos. 55947-1 and -24); and one 4.0 lb/gal SC/L K⁺ salt formulation (EPA Reg. No. 55947-38). These three products are registered for multiple broadcast applications to pasture grasses (including pasture for hay) and rangeland grasses. The maximum seasonal application rates are 2 lb ae/A for the DMA⁺ salts and 8 lb ae/A for the K⁺ salt (registrant's 5/17/94 letter states that the potassium salt is not marketed for use on pasture or grass crops). All labels indicate a preslaughter interval of 30 days. Feeding restrictions for lactating animals (7-60 days) and PHIs for hay (37-90 days) specified on the labels vary depending on the rate used (0.5-8.0 lb ae/A).

For all labels, the applications must be made in 3-50 GPA of water for ground and 1-20 GPA of water for aerial equipment. The 4.0 lb/gal SC/Ls DMA⁺ salt is the only label that allows low volume (<2 GPA) aerial applications. This label specifies that applications are to be made in 2-20 GPA for preharvest use, while all other uses can be applied in 1-10 GPA.

In response to the Dicamba SRR (6/89), Sandoz submitted data (1994; MRID 43370701) from a total of 295 tests conducted in FL (15), GA (35), IN (15), KS (15), TN (15), MI (15), NE (15), OK-1 (35), OK-2 (15), OR (35), MO (35), TX (15), and WI (35) depicting residues of dicamba and its 5-hydroxy metabolite in/on pasture/rangeland grasses. Three formulations were used: a DMA⁺ salt (4 lb/gal SC/L), a DGA⁺ salt (4 lb/gal SC/L), and a Na⁺ salt (2 lb/gal SC/L). One application of the DMA⁺ salt was made at 0.5, 1.0, or 2.0 lb ae/A in separate tests at each test site. For the DGA⁺ and Na⁺ salts, one application was made at 0.5 or 2.0 lb ae/A in separate tests at each test site; however, samples were collected only from WI, MO, OR, GA, and OK-1 test sites. Applications were made in 7-23 GPA of water using ground equipment to actively growing grasses. Forage and hay samples were collected at 0, 7, 14, 28, and 56-day post treatment intervals (PTI). Hay samples were allowed to field dry for 2-3 days prior to collection. One to two controls samples were collected from the 7, 14, 28, and 56-day PTI plots. One control was collected from the 0-day PTI plots for selected tests. One treated sample was collected from each test. Samples were stored at <-1 C for 72 to 402 days prior to analysis. Residues were determined using an adequate GC/ECD method (AM-0691B) described earlier in this report. Residue data are presented in Tables 3 through 8.

Geographic representation is adequate. The submitted field trial data are from tests conducted in Region 2, Region 3, Region 4, Region 5, Region 6, and Region 12. The Agency currently requires 12 field trials for grasses grown in all regions of the country (see EPA Guidance on Number and Location of Domestic Crop Field Trials for Establishment of Pesticide Residue Tolerance, 6/2/94). However, as the registrant submitted data from 295 test which were initiated in 1993, field trial data from tests conducted in Regions 1, 7, 8, 9, 10, 11, and 13 are not required.

Following a single application of the DMA⁺, DGA⁺, or Na⁺ salt SC/L formulations to actively growing grass at 0.5 lb ae/A with a 0-day PHI, the combined residues of dicamba and its 5-hydroxy metabolite were 20-81 ppm in on 23 forage samples and 5.7-472 ppm in/on 23 hay samples. The hay sample with the maximum residues at this treatment rate is an average of two analyses of a single field sample and appears to be an outlier. The combined residues were 5.7-120 ppm in/on the 22 other hay samples collected from the 0.5 lb ae/A, 0-day PHI trials. Following a single application of the DMA⁺ SC/L salt formulation at 1.0 lb ae/A with a 0-day PHI, the combined residues of dicamba and 5-hydroxy dicamba were 34-121 ppm in/on 13 forage samples and 22-231 ppm in/on 13 hay samples. Following a single application of the DMA⁺, DGA⁺, or Na⁺ salt SC/L formulations at 2.0 lb ae/A with a 0-day PHI, the combined residues were 66-359 ppm in/on 23 forage samples and 34-565 ppm in/on 23 hay samples.

The submitted grass field trials are adequate. The field trial data indicate that dicamba residue levels are not dependent on the salt formulation used. The registrant must amend all product labels registered for use on rangeland and pasture grasses to indicate a maximum seasonal rate of 2 lb ae/A. In addition, the Agency currently considers feeding restrictions, preslaughter intervals, and PHIs greater than zero days impractical for pasture and rangeland grasses (see the Updated Livestock Feeds Table for Subdivision O of the Pesticide Assessment Guidelines, 9/95). All product labels must be amended appropriately. Tolerances are set for grass forage and hay using the 0-day PHI data.

Based on the residue data reflecting a maximum seasonal use rate of 2.0 lb ae/A, tolerances of 400 ppm and 600 ppm would be appropriate for grass forage and hay, respectively.

Table 3. Residues of dicamba and its 5-hydroxy metabolite in/on grass forage harvested following one application at 0.5 lb ae/A of various dicamba salt formulations.

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
0	WI	39	0.31	39	45	0.39	45	42	0.39	42
	OK 1	41	0.024	41	32	0.018	32	23	0.017	23
	MO	20	0.13	20	22	0.099	22	25	0.12	25
	OR	31	0.017	31	20	0.017	20	29	0.021	29
	GA	78	0.089	78	55	0.061	55	57	0.056	57
	NE	28	0.11	28	NA ^b	NA	NA	NA	NA	NA
	OK 2	61	0.064	61	NA	NA	NA	NA	NA	NA
	FL	71	1.0	72	NA	NA	NA	NA	NA	NA
	MI	27	0.029	27	NA	NA	NA	NA	NA	NA
	KS	81	0.072	81	NA	NA	NA	NA	NA	NA
	IN	69	0.20	69	NA	NA	NA	NA	NA	NA
	TN	20	0.89	21	NA	NA	NA	NA	NA	NA
	TX	35	2.9	38	NA	NA	NA	NA	NA	NA
7	WI	9.0	3.6	13	5.5	4.6	10	5.2	3.4	8.6
	OK 1	8.0	1.1	9.1	2.6	0.59	3.2	9.2	1.3	11
	MO	10	5.7	16	10	6.2	16	9.3	5.5	15
	OR	2.0	0.081	2.1	1.6	0.084	1.7	3.5	0.32	3.8
	GA	10	15	25	6.3	10	16	41 (17) ^c	41 (17)	82 (29)
	NE	12	9.0	21	NA	NA	NA	NA	NA	NA
	OK 2	15	4.8	20	NA	NA	NA	NA	NA	NA
	FL	35	5.4	40	NA	NA	NA	NA	NA	NA
	MI	6.9	5.6	13	NA	NA	NA	NA	NA	NA
	KS	25	5.5	31	NA	NA	NA	NA	NA	NA
	IN	15	2.9	18	NA	NA	NA	NA	NA	NA
	TN	2.2	2.8	5.0	NA	NA	NA	NA	NA	NA
	TX	11	11	22	NA	NA	NA	NA	NA	NA

Table 3 (*continued*).

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
14	WI	4.3	2.4	6.7	2.4	5.4	7.8	3.1	3.1	6.2
	OK 1	1.7	0.39	2.1	2.8	0.91	3.7	4.1	2.7	6.8
	MO	4.2	4.4	8.6	5.8	6.7	13	6.6	6.3	13
	OR	3.6	0.15	3.8	8.0	0.40	8.4	5.5	0.14	5.6
	GA	7.1	8.8	16	7.7	14	22	4.3	5.5	9.8
	NE	2.7	6.4	9.1	NA	NA	NA	NA	NA	NA
	OK 2	11	6.8	18	NA	NA	NA	NA	NA	NA
	FL	26	7.0	33	NA	NA	NA	NA	NA	NA
	MI	3.0	4.2	7.2	NA	NA	NA	NA	NA	NA
	KS	11	2.9	14	NA	NA	NA	NA	NA	NA
	IN	16	2.0	18	NA	NA	NA	NA	NA	NA
	TN	2.5	3.4	5.9	NA	NA	NA	NA	NA	NA
	TX	4.5	6.2	11	NA	NA	NA	NA	NA	NA
28	WI	1.0	1.1	2.1	1.2	1.5	2.7	0.68	1.5	2.2
	OK 1	0.79	0.30	1.1	1.3	0.84	2.1	2.4	1.0	3.4
	MO	2.6	3.3	5.9	5.9	6.3	12	3.4	5.0	8.4
	OR	3.7	0.18	3.9	2.2	0.15	2.4	2.8	0.19	3.0
	GA	1.5	2.1	3.6	1.1	1.6	2.7	1.4	2.0	3.4
	NE	1.3	8.5	9.8	NA	NA	NA	NA	NA	NA
	OK 2	1.8	3.8	5.6	NA	NA	NA	NA	NA	NA
	FL	11	4.9	16	NA	NA	NA	NA	NA	NA
	MI	1.0	3.4	4.4	NA	NA	NA	NA	NA	NA
	KS	6.5	2.1	8.6	NA	NA	NA	NA	NA	NA
	IN	4.6	0.93	5.5	NA	NA	NA	NA	NA	NA
	TN	0.71	1.0	1.7	NA	NA	NA	NA	NA	NA
	TX	1.9	2.4	4.3	NA	NA	NA	NA	NA	NA

Table 3 (*continued*).

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
56	WI	0.74	1.0	1.7	0.45	1.2	1.7	0.38	0.76	1.1
	OK 1	0.75	0.19	0.94	0.34	0.14	0.48	0.33	0.10	0.43
	MO	1.8	0.91	2.7	1.4	0.93	2.3	0.92	0.80	1.7
	OR	1.3	0.038	1.3	0.59	0.019	0.61	3.3	0.076	3.4
	GA	0.30	0.22	0.52	0.21	0.18	0.39	1.0	0.80	1.8
	NE	0.64	4.7	5.3	NA	NA	NA	NA	NA	NA
	OK 2	1.2	2.1	3.3	NA	NA	NA	NA	NA	NA
	FL	0.53	0.44	1.0	NA	NA	NA	NA	NA	NA
	MI	0.80	2.2	3.0	NA	NA	NA	NA	NA	NA
	KS	2.5	0.57	3.1	NA	NA	NA	NA	NA	NA
	IN	3.0	0.30	3.3	NA	NA	NA	NA	NA	NA
	TN	0.74	0.81	1.6	NA	NA	NA	NA	NA	NA
	TX	3.2	4.1	7.3	NA	NA	NA	NA	NA	NA

* PTI is given in days.

b NA=not analyzed.

c Numbers listed parenthetically represent duplicate analyses of a single field sample.

Table 4. Residues of dicamba and its 5-hydroxy metabolite in/on grass hay harvested following one application at 0.5 lb ae/A of various dicamba salt formulations.

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
0	WI	571 (333)	23 (18)	594 (351)	99	11	110	110	10	120
	OK 1	47	0.99	48	36	0.75	37	62	1.2	63
	MO	42	0.21	42	29	0.20	29	51	0.35	51
	OR	11	0.13	11	9.1	0.18	9.3	14	0.26	14
	GA	87	2.1	89	65	1.1	66	60	0.89	61
	NE	54	3.4	57	NA ^c	NA	NA	NA	NA	NA
	OK 2	101	0.20	101	NA	NA	NA	NA	NA	NA
	FL	76	1.3	77	NA	NA	NA	NA	NA	NA
	MI	44	1.4	45	NA	NA	NA	NA	NA	NA
	KS	49	5.1	54	NA	NA	NA	NA	NA	NA
	IN	102	2.5	105	NA	NA	NA	NA	NA	NA
	TN	5.0	0.67	5.7	NA	NA	NA	NA	NA	NA
	TX	77	4.2	81	NA	NA	NA	NA	NA	NA
7	WI	21	11	32	18	15	33	21	12	33
	OK 1	20	1.2	21	14	2.6	17	29	4.6	34
	MO	5.7	5.0	11	9.7	6.7	16	7.1	5.2	12
	OR	5.6	0.19	5.8	5.3	0.16	5.5	7.2	0.31	7.5
	GA	18	14	32	14	10	24	18	8.6	27
	NE	12	19	31	NA	NA	NA	NA	NA	NA
	OK 2	30	13	43	NA	NA	NA	NA	NA	NA
	FL	36	8.0	44	NA	NA	NA	NA	NA	NA
	MI	11	6.3	17	NA	NA	NA	NA	NA	NA
	KS	28	5.8	34	NA	NA	NA	NA	NA	NA
	IN	306 (310)	33 (23)	339 (333)	NA	NA	NA	NA	NA	NA
	TN	5.9	4.8	11	NA	NA	NA	NA	NA	NA
	TX	21	17	38	NA	NA	NA	NA	NA	NA

Table 4 (*continued*).

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
14	WI	4.2	2.7	6.9	2.5	4.1	6.6	1.2	2.7	3.9
	OK 1	4.0	1.4	5.4	6.0	4.1	10	7.8	4.7	13
	MO	5.8	8.2	14	55 (9.8)	46 (10)	101 (20)	8.9	11	20
	OR	3.2	0.067	3.3	4.1	0.10	4.2	4.1	0.088	4.2
	GA	8.1	7.9	16	8.5	6.1	15	7.1	5.9	13
	NE	4.5	15	20	NA	NA	NA	NA	NA	NA
	OK 2	15	9.8	25	NA	NA	NA	NA	NA	NA
	FL	38	9.8	48	NA	NA	NA	NA	NA	NA
	MI	3.7	4.1	7.8	NA	NA	NA	NA	NA	NA
	KS	18	4.9	23	NA	NA	NA	NA	NA	NA
	IN	48	6.4	54	NA	NA	NA	NA	NA	NA
	TN	3.5	4.1	7.6	NA	NA	NA	NA	NA	NA
	TX	11	13	24	NA	NA	NA	NA	NA	NA
28	WI	4.1	4.6	8.7	4.6	6.2	11	1.4	6.7	8.1
	OK 1	1.7	0.31	2.0	2.1	0.93	3.0	21	4.8	26
	MO	4.5	2.6	7.1	3.3	2.0	5.3	4.3	3.1	7.4
	OR	7.7	0.44	8.1	5.3	0.24	5.5	6.0	0.22	6.2
	GA	4.3	5.2	9.5	1.8	2.5	4.3	2.5	3.3	5.8
	NE	1.4	13	14	NA	NA	NA	NA	NA	NA
	OK 2	6.8	13	20	NA	NA	NA	NA	NA	NA
	FL	19	7.8	27	NA	NA	NA	NA	NA	NA
	MI	3.1	8.4	12	NA	NA	NA	NA	NA	NA
	KS	8.6	2.6	11	NA	NA	NA	NA	NA	NA
	IN	16	1.6	18	NA	NA	NA	NA	NA	NA
	TN	3.2	2.8	6.0	NA	NA	NA	NA	NA	NA
	TX	6.9	11	18	NA	NA	NA	NA	NA	NA

Table 4 (*continued*).

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
56	WI	0.82	1.5	2.3	0.81	1.3	2.1	0.40	1.4	1.8
	OK 1	0.36	0.14	0.50	0.078	0.040	0.12	0.93	0.18	1.1
	MO	2.2	1.1	3.3	2.7	1.1	3.8	3.4	1.7	5.1
	OR	2.9	0.11	3.0	2.2	0.058	2.3	2.3	0.083	2.4
	GA	0.40	0.52	0.92	0.069	0.086	0.16	0.26	0.27	0.53
	NE	0.74	4.9	5.6	NA	NA	NA	NA	NA	NA
	OK 2	0.88	1.4	2.3	NA	NA	NA	NA	NA	NA
	FL	1.6	1.4	3.0	NA	NA	NA	NA	NA	NA
	MI	1.2	1.0	2.2	NA	NA	NA	NA	NA	NA
	KS	2.4	0.44	2.8	NA	NA	NA	NA	NA	NA
	IN	2.6	0.60	3.2	NA	NA	NA	NA	NA	NA
	TN	0.96	0.97	1.9	NA	NA	NA	NA	NA	NA
	TX	2.9	3.6	6.5	NA	NA	NA	NA	NA	NA

* PTI is given in days.

b Numbers listed parenthetically represent duplicate analyses of a single field sample.

c NA=not analyzed.

Table 5. Residues of dicamba and its 5-hydroxy metabolite in/on grass forage harvested following one application at 1.0 lb ae/A of the DMA⁺ salt formulation.

PTI *	Loc	Residues (ppm)		
		Dicamba	S-OH	Total
0	WI	64	0.49	64
	OK 1	81	0.063	81
	MO	53	0.25	53
	OR	43	0.037	43
	GA	88	0.10	88
	NE	34	0.086	34
	OK 2	119	0.082	119
	FL	120	0.90	121
	MI	75	0.16	75
	KS	116	0.088	116
	IN	116	0.51	117
	TN	78	3.1	81
	TX	84	4.7	89
7	WI	16	8.4	24
	OK 1	10	1.5	12
	MO	25	9.4	34
	OR	5.1	0.12	5.2
	GA	21	25	46
	NE	15	13	28
	OK 2	30	14	44
	FL	33	5.3	38
	MI	29	19	48
	KS	30	7.2	37
	IN	41	3.5	45
	TN	7.4	10	17
	TX	25	24	49

Table 5 (*continued*).

PTI *	Loc	Residues (ppm)		
		Dicamba	5-OH	Total
14	WI	9.5	7.7	17
	OK 1	6.8	3.0	10
	MO	14	11	25
	OR	12	0.31	12
	GA	8.6	8.8	17
	NE	3.9	15	19
	OK 2	17	15	32
	FL	26	6.1	32
	MI	6.5	8.8	15
	KS	24	5.0	29
	IN	27	4.8	32
	TN	2.4	3.8	6.2
	TX	8.0	12	20
28	WI	2.5	2.8	5.3
	OK 1	1.2	0.46	1.7
	MO	11	9.9	21
	OR	7.4	0.21	7.6
	GA	3.0	4.1	7.1
	NE	1.6	8.4	10
	OK 2	6.3	8.1	14
	FL	19	10	29
	MI	3.3	5.6	8.9
	KS	14	3.1	17
	IN	17	1.1	18
	TN	2.5	3.4	5.9
	TX	2.6	4.2	6.8

Table 5 (*continued*).

PTI *	Loc	Residues (ppm)		
		Dicamba	5-OH	Total
56	WI	0.90	1.5	2.4
	OK 1	0.88	0.45	1.3
	MO	3.6	1.7	5.3
	OR	3.0	0.060	3.1
	GA	0.46	0.39	0.85
	NE	0.80	7.9	8.7
	OK 2	1.1	2.5	3.6
	FL	0.72	0.57	1.3
	MI	1.6	2.1	3.7
	KS	3.4	0.77	4.2
	IN	1.4	0.59	2.0
	TN	1.6	2.0	3.6
	TX	3.1	3.2	6.3

* PTI is given in days.

Table 6. Residues of dicamba and its 5-hydroxy metabolite in/on grass hay harvested following one application at 1.0 lb ae/A of the DMA⁺ salt formulation.

PTI *	Loc	Residues (ppm)		
		Dicamba	5-OH	Total
0	WI	92	10	102
	OK 1	44	2.4	46
	MO	92	0.41	92
	OR	50	0.47	50
	GA	43	6.3	49
	NE	97	7.9	105
	OK 2	199	0.43	199
	FL	18	4.3	22
	MI	225	6.3	231
	KS	79	2.9	82
	IN	98	12	110
	TN	110	2.1	112
	TX	93	0.16	93
7	WI	25	0.68	26
	OK 1	24	5.1	29
	MO	25	15	40
	OR	12	0.30	12
	GA	31	22	53
	NE	17	31	48
	OK 2	53	23	76
	FL	20	3.3	23
	MI	29	23	52
	KS	40	4.4	44
	IN	163 (154) ^b	14 (9.2)	177 (163)
	TN	7.3	10	17
	TX	34	27	61

Table 6 (*continued*).

PTI *	Loc	Residues (ppm)		
		Dicamba	5-OH	Total
14	WI	5.1	6.3	11
	OK 1	15	6.6	22
	MO	23	20	43
	OR	6.5	0.084	6.6
	GA	14	13	27
	NE	6.7	29	36
	OK 2	27	24	51
	FL	55	15	70
	MI	3.7	4.1	7.8
	KS	30	7.3	37
	IN	97 (99)	10 (7.8)	107 (107)
	TN	5.8	8.4	14
	TX	19	23	42
28	WI	3.7	6.7	10
	OK 1	3.0	1.3	4.3
	MO	8.7	3.9	13
	OR	17	0.42	17
	GA	5.2	6.3	12
	NE	2.2	14	16
	OK 2	13	19	32
	FL	40	20	60
	MI	6.5	11	18
	KS	17	4.5	22
	IN	36	4.0	40
	TN	3.4	2.6	6.0
	TX	12	18	30

Table 6 (*continued*).

PTI *	Loc	Residues (ppm)		
		Dicamba	5-OH	Total
56	WI	1.1	2.2	3.3
	OK 1	0.50	0.24	0.74
	MO	5.5	2.4	7.9
	OR	5.4	0.10	5.5
	GA	0.32	0.48	0.80
	NE	0.84	5.5	6.3
	OK 2	1.7	2.0	3.7
	FL	1.9	1.7	3.6
	MI	1.5	1.7	3.2
	KS	7.1	1.6	8.7
	IN	8.5	0.77	9.3
	TN	1.6	1.3	2.9
	TX	4.7	2.1	6.8

* PTI is given in days.

* Numbers listed parenthetically represent duplicate analyses of a single field sample.

Table 7. Residues of dicamba and its 5-hydroxy metabolite in/on grass forage harvested following one application at 2.0 lb ae/A of various dicamba salt formulations.

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
0	WI	98	0.30	98	98	0.32	98	99	0.26	99
	OK 1	131	0.037	131	123	0.052	123	131	0.036	131
	MO	82	0.18	82	75	0.17	75	92	0.23	92
	OR	71	0.051	71	69	0.041	69	94	0.043	94
	GA	251	0.18	251	244	0.12	244	358	0.15	358
	NE	115	0.23	115	NA ^b	NA	NA	NA	NA	NA
	OK 2	138	0.13	138	NA	NA	NA	NA	NA	NA
	FL	206	2.7	209	NA	NA	NA	NA	NA	NA
	MI	96	0.29	96	NA	NA	NA	NA	NA	NA
	KS	273	0.087	273	NA	NA	NA	NA	NA	NA
	IN	240	0.44	240	NA	NA	NA	NA	NA	NA
	TN	99	2.3	101	NA	NA	NA	NA	NA	NA
	TX	64	1.9	66	NA	NA	NA	NA	NA	NA
7	WI	35	18	53	27	6.0	33	19	13	32
	OK 1	18	5.7	24	24	5.1	29	28	2.9	31
	MO	57	20	77	79	20	99	54	17	71
	OR	16	0.37	16	8.0	0.20	8.2	9.4	0.28	9.7
	GA	52	56	108	45	41	86	8.2	10	18
	NE	35	29	64	NA	NA	NA	NA	NA	NA
	OK 2	53	23	76	NA	NA	NA	NA	NA	NA
	FL	163	29	192	NA	NA	NA	NA	NA	NA
	MI	85	118	203	NA	NA	NA	NA	NA	NA
	KS	50	10	60	NA	NA	NA	NA	NA	NA
	IN	131	15	146	NA	NA	NA	NA	NA	NA
	TN	7.9	9.2	17	NA	NA	NA	NA	NA	NA
	TX	78	52	130	NA	NA	NA	NA	NA	NA

Table 7 (*continued*).

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
14	WI	10	16	26	13	17	30	13	13	26
	OK 1	18	8.8	27	6.2	1.5	7.7	28	4.8	33
	MO	34	19	53	52	22	74	28	16	44
	OR	23	0.44	23	24	0.45	24	16	0.27	16
	GA	36	32	68	22	46	68	47	41	88
	NE	6.4	29	35	NA	NA	NA	NA	NA	NA
	OK 2	64	43	107	NA	NA	NA	NA	NA	NA
	FL	81	20	101	NA	NA	NA	NA	NA	NA
	MI	15	29	44	NA	NA	NA	NA	NA	NA
	KS	35	7.2	42	NA	NA	NA	NA	NA	NA
	IN	83	12	95	NA	NA	NA	NA	NA	NA
	TN	4.1	7.0	11	NA	NA	NA	NA	NA	NA
	TX	19	23	42	NA	NA	NA	NA	NA	NA
28	WI	3.8	3.2	7.0	5.1	11	16	3.9	3.7	7.6
	OK 1	2.5	0.70	3.2	8.6	5.2	14	14	4.0	18
	MO	33	22	55	23	17	40	28	20	48
	OR	12	0.31	12	18	0.47	18	15	0.49	15
	GA	6.6	9.8	16	5.2	7.8	13	6.4	9.7	16
	NE	2.8	22	25	NA	NA	NA	NA	NA	NA
	OK 2	12	19	31	NA	NA	NA	NA	NA	NA
	FL	35	15	50	NA	NA	NA	NA	NA	NA
	MI	3.8	19	23	NA	NA	NA	NA	NA	NA
	KS	18	3.7	22	NA	NA	NA	NA	NA	NA
	IN	57	3.4	60	NA	NA	NA	NA	NA	NA
	TN	5.5	5.7	11	NA	NA	NA	NA	NA	NA
	TX	6.3	7.2	14	NA	NA	NA	NA	NA	NA

Table 7 (*continued*).

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
56	WI	2.6	4.0	6.6	1.6	6.7	8.3	0.72	2.2	2.9
	OK 1	2.3	0.91	3.2	2.4	0.94	3.3	4.7	1.6	6.3
	MO	8.0	2.8	11	10	3.5	14	7.3	2.5	9.8
	OR	4.9	0.10	5.0	2.6	0.17	2.8	1.0	0.029	1.0
	GA	0.51	0.43	0.94	0.42	0.37	0.79	0.17	0.22	0.39
	NE	2.1	12	14	NA	NA	NA	NA	NA	NA
	OK 2	2.6	3.6	6.2	NA	NA	NA	NA	NA	NA
	FL	1.6	1.2	2.8	NA	NA	NA	NA	NA	NA
	MI	1.8	5.6	7.4	NA	NA	NA	NA	NA	NA
	KS	4.6	1.4	6.0	NA	NA	NA	NA	NA	NA
	IN	5.0	0.42	5.4	NA	NA	NA	NA	NA	NA
	TN	2.0	1.9	3.9	NA	NA	NA	NA	NA	NA
	TX	9.0	5.8	15	NA	NA	NA	NA	NA	NA

* PTI is given in days.

b NA=not analyzed.

Table 8. Residues of dicamba and its 5-hydroxy metabolite in/on grass hay harvested following one application at 2.0 lb ae/A of various dicamba salt formulations.

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
0	WI	116	8.2	124	287	13	300	342	29	371
	OK 1	174	5.4	179	231	3.8	235	206	1.8	208
	MO	136	1.0	137	132	1.1	133	134	0.98	135
	OR	33	0.53	34	49	0.47	49	44	0.65	45
	GA	310	3.7	314	509	4.4	513	559	5.5	565
	NE	227	13	240	NA ^b	NA	NA	NA	NA	NA
	OK 2	412	0.51	413	NA	NA	NA	NA	NA	NA
	FL	487	6.0	493	NA	NA	NA	NA	NA	NA
	MI	202	0.86	203	NA	NA	NA	NA	NA	NA
	KS	245	5.2	250	NA	NA	NA	NA	NA	NA
	IN	477	3.4	480	NA	NA	NA	NA	NA	NA
	TN	82	10	92	NA	NA	NA	NA	NA	NA
	TX	346	7.2	353	NA	NA	NA	NA	NA	NA
7	WI	138	63	201	64	45	109	45	1.9	47
	OK 1	64	14	78	126	22	148	71	5.7	77
	MO	63	32	95	38	17	55	39	20	59
	OR	28	0.36	28	29	0.40	29	38	1.0	39
	GA	63	36	99	61	42	103	62	31	93
	NE	26	51	77	NA	NA	NA	NA	NA	NA
	OK 2	77	18	95	NA	NA	NA	NA	NA	NA
	FL	155	33	188	NA	NA	NA	NA	NA	NA
	MI	54	52	106	NA	NA	NA	NA	NA	NA
	KS	72	9.4	81	NA	NA	NA	NA	NA	NA
	IN	67	8.4	75	NA	NA	NA	NA	NA	NA
	TN	12	13	25	NA	NA	NA	NA	NA	NA
	TX	120	59	179	NA	NA	NA	NA	NA	NA

Table 8 (*continued*).

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
14	WI	14	21	35	8.0	16	24	23	12	35
	OK 1	28	20	48	30	19	49	31	5.7	37
	MO	47	37	84	48	37	85	56	46	102
	OR	32	0.38	32	27	0.35	27	11	0.35	11
	GA	39	29	68	39	29	68	36	34	70
	NE	15	53	68	NA	NA	NA	NA	NA	NA
	OK 2	57	47	104	NA	NA	NA	NA	NA	NA
	FL	138	35	173	NA	NA	NA	NA	NA	NA
	MI	6.3	13	19	NA	NA	NA	NA	NA	NA
	KS	49	13	62	NA	NA	NA	NA	NA	NA
	IN	220 (227) °	28 (19)	248 (246)	NA	NA	NA	NA	NA	NA
	TN	8.8	11	20	NA	NA	NA	NA	NA	NA
	TX	39	43	82	NA	NA	NA	NA	NA	NA
28	WI	16	23	39	15	29	44	14	15	29
	OK 1	7.0	2.3	9.3	7.5	5.1	13	3.0	1.6	4.6
	MO	33	11	44	23	9.9	33	17	7.0	24
	OR	44	1.2	45	37	0.71	38	50	1.4	51
	GA	10	13	23	12	16	28	9.3	13	22
	NE	6.5	35	42	NA	NA	NA	NA	NA	NA
	OK 2	26	41	67	NA	NA	NA	NA	NA	NA
	FL	53	25	78	NA	NA	NA	NA	NA	NA
	MI	8.2	24	32	NA	NA	NA	NA	NA	NA
	KS	28	7.3	35	NA	NA	NA	NA	NA	NA
	IN	110 (87)	13 (5.9)	123 (93)	NA	NA	NA	NA	NA	NA
	TN	5.5	3.9	9.4	NA	NA	NA	NA	NA	NA
	TX	28	14	42	NA	NA	NA	NA	NA	NA

Table 8 (continued).

PTI *	Loc	DMA ⁺ Salt			DGA ⁺ Salt			Na ⁺ Salt		
		Dicamba	5-OH	Total	Dicamba	5-OH	Total	Dicamba	5-OH	Total
56	WI	4.0	6.9	11	2.7	9.2	12	1.4	2.8	4.2
	OK 1	5.5	1.7	7.2	0.92	0.11	1.0	3.9	1.0	4.9
	MO	14	4.2	18	6.8	2.3	9.1	15	4.1	19
	OR	19	0.62	20	12	0.32	12	7.7	0.21	7.9
	GA	0.58	0.54	1.1	1.0	1.3	2.3	0.10	0.17	0.27
	NE	2.2	15	17	NA	NA	NA	NA	NA	NA
	OK 2	6.3	7.7	14	NA	NA	NA	NA	NA	NA
	FL	4.6	3.2	7.8	NA	NA	NA	NA	NA	NA
	MI	2.1	6.3	8.4	NA	NA	NA	NA	NA	NA
	KS	8.1	2.2	10	NA	NA	NA	NA	NA	NA
	IN	6.1	1.0	7.1	NA	NA	NA	NA	NA	NA
	TN	2.4	1.6	4.0	NA	NA	NA	NA	NA	NA
	TX	5.5	2.2	7.7	NA	NA	NA	NA	NA	NA

* PTI is given in days.

b NA = not analyzed.

c Numbers listed parenthetically represent duplicate analyses of a single field sample.

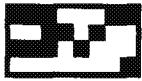
MASTER RECORD IDENTIFICATION NUMBER

The citation for the MRID document used in this review is presented below.

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Date:	12/14/93
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CBRS No.:	12546
DP Barcode:	D195031
Subject:	Response to the Dicamba Reregistration Standard
From:	R. Perfetti
To:	L. Rossi
Date:	10/20/93
MRID(s):	None
CBRS No.:	11617 and 11626
DP Barcode:	D189393 and D189595
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From:	S. Knizner
To:	J. Mitchell
Date:	6/11/93
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